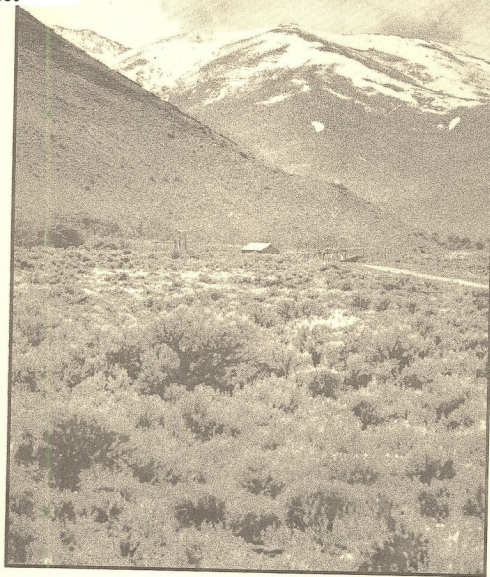


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Optimal Livestock Production Strategies on the Saval Ranch

L. Allen Torell, E. Bruce Godfrey and Richard E. Eckert, Jr.

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The objectives and rationale of the Saval grazing system as outlined in the Saval Coordinated Management Plan (USDI-BLM, April 1981) are as follows:

- A. Improve livestock distribution on all pastures by
 - 1) implementing grazing systems with proper fencing, 2) providing water developments away from major creek bottoms, 3) have the permittee provide at least one range rider, and 4) have the permittee place salt a minimum of one-quarter mile from waters, with subsequent salting on the same location.
- B. Improve range conditions from poor to good and increase production to 60 percent of potential within 15 years after implementation of the grazing systems on 3,639 acres. Improve range condition from fair to good and increase production to 70 percent of potential within 15 years after implementation on 30,948 acres.
- C. Increase hay production from current levels to 3,000-3,400 tons within six years through the following treatments:
 - 1. Grading and shaping
 - 2. Seeding as needed
 - 3. Willow control
 - 4. Water control structures
 - 5. Main supply ditches
 - 6. Contour ditch systems
 - 7. Fertilization
 - 8. Waterspreading
 - 9. Pasture and hayland management
 - 10. Sediment basin on Mahala Creek on Upper Tremewan Field
 - 11. Noxious weed control
- D. Eliminate active headcutting of streams directly affecting or threatening Lahonton Cutthroat Trout habitat within three years after implementation.
- E. Minimize forced moves of cattle for management or distribution to maximize weight gain.
- F. Increase calf crop from 70 to 80 percent (based on number of calves weaned as a percentage of total cows exposed) within ten years after implementation.
- G. Increase weaning weights from 350 to 450 pounds, and increase yearling weights from 650 to 750 pounds within 10 years after implementation.

ESTIMATED LIVESTOCK BENEFITS OF THE GRAZING SYSTEM

Livestock benefits from the grazing system are assumed to be as outlined above as objectives F and G--i.e., calf crop and selling weights are assumed to increase. One difference in assumed benefits was made. Calf crop is assumed to increase from 80 percent to 85 percent seven years after implementation of the grazing system. This compares to objective F of the Saval Management Plan, whereby, calf crop was estimated to increase from 70 to 80 percent. This adjustment was made since the Saval Ranch should be able to achieve an 80 percent calf crop (the average calf crop in Elko County, Myer and Hackett, 1981) through improved breeding management without the grazing system. This 10 percent improvement of calf crop was analyzed earlier as Option 3.

After the grazing system has been in place for seven years, selling weights of livestock sold are expected to reflect levels similar to those outlined under objective G of the grazing management plan. Average selling weight of heifer calves was assumed to be 398 pounds, a 43 pound increase in selling weight over the levels used for the season-long analysis (Option 5). Steer calves are expected to weigh an average of 437 pounds (including a three percent sales shrink). Average steer yearling selling weight is expected to be 728 pounds.

A major expected livestock benefit of the grazing system will be increased livestock forage availability and grazing capacity. Better livestock distribution, additional fences, water developments, seedings, and herding should increase livestock forage availability. Determining how much it increases is of

course a major objective of the Saval Study. In this preliminary look at the economics of the grazing system, we assumed grazing capacity on all federal allotments (native and seedings) would increase by 10 percent within seven years after implementation of the system. Forage production on the privately owned Tremewan Seeding and the South Allaback Pasture was also assumed to increase by 10 percent.

An additional 15 percent livestock forage increase is assumed to occur at three-year intervals after system implementation within the the 13-year time frame between year seven and year 20. The corresponding total forage increase from the grazing system is estimated to be 25 percent, including the additional forage available from the Lower Sheep Creek Seeding. Figure 7 outlines the assumed total annual forage base of the ranch by year (including all federal and private sources) over the 50 year planning horizon considered in the economic analysis. Note that not all forage shown would be harvested in the year indicated. The rest-rotation system implemented on BLM native range calls for resting either Middle Mahala Creek, Upper Mahala Creek, or Upper Sheep Creek pasture each year (Table 22). The appropriate number of AUM's for the pasture rested must be subtracted from the forage base outlined in Figure 7. Furthermore, LP model results indicate that some additional forage would go unused because of seasonal forage restrictions (Table 22).

The level of forage increase by year, as outlined above, reflects the "best guess" of the range scientists working on the Saval research project. This estimate is based on professional

Table 22. Forage Availability and Forage Use for Selected Years of the Grazing System.

Year	Pasture Rested	Total Forage Available (AUMs)	Forage Rested (AUMs)	Additional Unused Forage (AUMs)	Total Forage Used (AUMs)
1984	M. Mahala	14991	237	264	14490
1985	U. Mahala	14991	367	256	14368
1986	U. Sheep	14991	499	166	14326
1987	M. Mahala	14991	237	266	14488
1988	U. Mahala	14991	367	256	14368
1989	U. Sheep	14991	499	166	14326
1990	M. Mahala	15797	261	0	15536
1993	M. Mahala	16076	269	259	15819
1996	M. Mahala	16355	277	259	15819
1999	M. Mahala	16634	285	0	16349
2003	U. Mahala	17007	459	0	16548

experience. Similarly, objective B of the management plan was thought to be a possible goal for improving range condition.

BENEFIT/COST ANALYSIS OF THE GRAZING SYSTEM

The LP model developed for the ranch was used to estimate the annual economic benefits of the Saval grazing system. Selected years of the grazing system were simulated to estimate optimal livestock production with available forage and assumed production parameters.

The grazing system includes very restrictive seasonal forage availability constraints. For example, year one of the grazing system requires that the East Darling Seeding be grazed only from April 15 until May 8 (Table 21) while the Upper Sheep Creek pasture can be grazed only from June 1 until June 15. Similar seasonal forage availability restrictions were also included for other federally managed pastures. While the plan does allow for some flexibility, the seasonal constraints on forage availability are restrictive in terms of livestock movements and grazing use. Similar forage availability restrictions are outlined for other years of the grazing system in Table 21 as taken from the Saval Management Plan (USDI-BLM, 1981a).

Initial model simulations of the grazing system indicated that in some years a large number of crested wheatgrass AUM's could not be used because of seasonal forage use restrictions. The system calls for grazing one pasture of the Darling Seeding and the new Lower Sheep Creek Seeding only in the spring of some years. These two seedings provide considerably more forage than could be

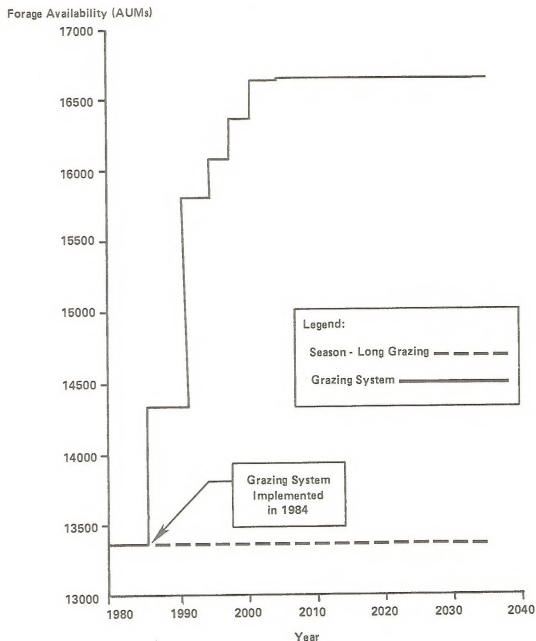


Figure 7. Total Annual Forage Availability Under "Traditional" Grazing and Under the Grazing System.

utilized in the short one and a half month grazing period. Thus, seasonal forage limitations imposed by the management plan would force some seeding AUM's to go unused. This is in addition to the AUM's which must go unused to rest and defer native BLM and USFS pastures as dictated by the management plan.

As indicated above, under the management plan a surplus of seeding AUM's is realized during the spring. Since spring grazing is considered to have the most detrimental impact on plants, perhaps the BLM would allow fall use of these excess AUM's. For analysis purposes it was assumed they would. Even with this adjustment the grazing system does not provide complete forage balance. Some forage would still be forced into non-use (Table 22). It is likely that stocking rates on the various federal allotments will have more variability and flexibility than has been outlined here, however, allowed stocking rates and seasons of use on federal rangelands are set exactly even though the estimate of proper stocking may be crude. It is important that federal agencies be willing to make seasonal use adjustments where needed to assure adequate forage balance for the Saval Ranch. Otherwise, the seasonal use constraints of the grazing system may be unduly restrictive.

Grazing System Economics

Table 23 summarizes the Benefit/Cost (BC) analysis of the Saval grazing system. The system is compared to the "optimal" livestock production under season-long grazing whereby hayland improvement is assumed to have been implemented, livestock production has been improved over current levels, the ranch is operated as a cow-calf/

Table 23. Benefit/Cost Analysis of the Saval Grazing System.

Year	Number of Cows	Change In Cow Number	Gross Sales	Change In Gross Sales	Increased Grazing Fees	Total Benefit	Total Livestock Costs	Change In Livestock	Livestock Purchase/ Sold	Range Improvement	Change In Costs	Net Annual Benefit
	(head)	(head)	(\$)	(\$)	(\$)	(\$)	(\$)	(\$)	(\$)	(\$)	(\$)	(\$)
1983	762	0	250357	0	0	0	221603	0		192926	192926	-192926
1984	783	21	257257	6900	1963	6900	226334	4731	9200	3126	17057	-8194
1985	783	21	257257	6900	1963	6900	226334	4731		3126	7857	1006
1986	783	21	257257	6900	1963	6900	226334	4731		3126	7857	1006
1987	783	21	257257	6900	1963	6900	226334	4731		3126	7857	1006
1989	783	21	257257	6900	1963	6900	226334	4731		3126	7857	1006
1991	783	21	257257	6900	1963	6900	226334	4731		3126	7857	1006
1992	833	71	297899	47542	2746	50288	238220	16617	22400	3126	42143	8145
1993	833	71	297899	47542	2746	50288	238220	16617		3126	19743	30545
1994	833	71	297899	47542	2746	50288	238220	16617		3126	19743	30545
1995	833	71	297899	47542	2746	50288	238220	16617		3126	19743	30545
1996	833	71	297899	47542	2746	50288	238220	16617		3126	19743	30545
1997	833	71	297899	47542	2746	50288	238220	16617		3126	19743	30545
1998	848	86	303264	52907	3184	56091	240102	18499	6800	3126	28425	27666
1999	848	86	303264	52907	3184	56091	240102	18499		3126	21625	34466
2000	848	86	303264	52907	3184	56091	240102	18499		3126	21625	34466
2001	877	115	313635	63278	4121	67399	245622	24019	13200	3126	40345	27054
2002	877	115	313635	63278	4121	67399	245622	24019		3126	27145	40254
2003	877	115	313635	63278	4121	67399	245622	24019		3126	27145	40254
2004	877	115	313635	63278	4121	67399	245622	24019		3126	27145	40254
2005	877	125	317211	66854	4430	71284	247327	25724	4000	3126	32850	38434
2006-33	887	125	317211	66854	4430	71284	247327	25724		3126	28850	42434
2034	887	125	317211	66854	4430	71284	247327	25724	-55600	3126	-26750	98034
Net Present Value (@ 7.875%)						\$513314					\$445224	\$68090
Internal Rate of Return (%)												9.54
Benefit/Cost Ratio (@ 7.875%)												1.15

yearling operation, and herd size has been adjusted to 762 brood cows (Option 5). Before implementation of the grazing system in 1984 a total of \$192,926 of range improvements is estimated to have been implemented (Table 13). Increased annual maintenance of these improvements is estimated to be \$3,126.

A total increase of \$55,600 in breeding stock would be needed to beneficially utilize increased available forage. These brood stock would be purchased at various years as additional forage became available. Livestock production costs would increase from \$221,603 under season-long grazing to an estimated \$247,327 (Table 23). Gross annual livestock sales would increase by \$66,854 over the 50 year planning horizon, a 26.7 percent increase.

Present value or present net worth of the range improvements and grazing management system is estimated to be \$68,090 when a discount rate of 7-7/8 percent is considered. If the discounting rate of interest were 9.54 percent, present value of the project would equal zero. This indicates that returns to range improvements are sufficient to repay improvement and maintenance costs, pay 9.54 percent interest on these costs (assuming they were borrowed), purchase additional brood stock, pay additional production costs, and just break even on the investment. In other words, the internal rate of return is 9.54 percent.

The benefit cost ratio is 1.15, indicating the present value of monetary livestock benefits exceeds the present value of costs by 15 percent. Benefits to wildlife, watershed, and other resource values are also expected to accrue. In fact, the major objective

of the grazing system is not to provide only livestock benefits, but to improve vegetative condition and resource values. If benefits to these non-livestock resource uses were included in the analysis, the economics of the grazing system would be higher.

The grazing system is, however, estimated to be cost effective based solely on benefits to livestock. This result does depend upon the ranch improving hayland or taking other measures to provide adequate winter forage. The economics of the grazing system would not be nearly so beneficial if meadow improvement practices were not undertaken. Purchase of significant amounts of hay each year would greatly increase production costs. Increased hay production, outlined as objective C of the Saval Management Plan, appears to be of utmost importance if the ranch is to maintain year-round forage balance, not become dependent upon purchase hay, and realize positive economic benefits from additional range forage resources.

SUMMARY OF THE ECONOMICS OF THE SAVAL GRAZING SYSTEM

Before the Saval grazing system is fully implemented an estimated \$192,926 will have been invested in range improvements. Annual maintenance of these improvements will cost an additional \$3,126 per year. The relevant question is whether this is a worthwhile expenditure of federal and private dollars.

When the Lower Sheep Creek Seeding was considered as an integral part of the grazing system, along with water developments, fencing and grazing management, the \$192,926 range improvement investment is estimated to be beneficial based totally on livestock

production benefits. Net present value of range improvements and the grazing system is estimated to be \$68,080. The internal rate of return is estimated at 9.5 percent with a benefit/cost ratio of 1.15:1. However, this result is very dependent upon improvement of hay meadows or some other management action to assure continued year-round forage balance.

With the addition of the grazing system, "optimal" herd size is estimated to increase from 762 brood cows (the optimal level of production under season-long grazing) to 887 head of cows after all projected forage increases are realized. Gross livestock sales are estimated to increase by \$66,854 annually by year 2005. After production costs are subtracted, annual net ranch income is projected to increase by \$42,434 as a direct result of the grazing system and range improvements.

The grazing system is, therefore, estimated to be cost effective. Livestock production benefits are estimated to fully cover implementation cost and maintenance of the system. Additional expected wildlife and watershed benefits, which were not included in the B/C analysis, will further improve the economics of the grazing system.

The analysis conducted is, however, a preproject implementation or preliminary analysis; only projected benefits and costs are included. The primary project analysis will come after all or most benefits and costs have been realized when a similar B/C analysis can be performed using actual increases in forage and livestock production.

FOOTNOTES

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5. Personal Communication. Charles Speth, Animal Scientist, University of Nevada-Reno, January 6, 1983.
6. Goroian, L. 1981. Progress report for the economics section of the Saval Ranch research project. Unpublished Report. 14 p.
7. The value of labor and management has been included in the production costs outlined in table 6. Thus, "return to land and capital" reflects the residual income which is available as compensation for investment in real estate and working capital. It says nothing about who owns the capital. The Saval Ranch, like nearly all other ranches, must use part of this return to pay principal and interest on livestock, operating capital and real estate loans. If the "return to land and capital" is negative, as it is in this case, ranch income must be subsidized from some outside source(s). A more reflective measure of returns to ranching is the "return to owned capital", whereby, interest and principal payments on loans have been included in the income statement. This procedure was not followed however, in order to avoid disclosure of personal information.
8. Personal Communication. Jeff Dahl, range revegetation contractor, Wells, Nevada, June 11, 1982.
9. USDI, Bureau of Land Management (USDI-BLM). 1981. Memorandum to Elko BLM District office regarding seed procurement for land rehabilitation.
10. Personal Communication. Representative of Jacklin Seed Company, Post Falls, Idaho, March 17, 1983.
11. Personal Communication. Terry Daily, BLM District Office, Elko, Nevada, March 17, 1983.
12. Personal Communication. Leland Campsey, District Conservationist, Soil Conservation Service, Elko, Nevada. April 1982.

13. Personal Communication. Irving Hackett, State Range Extension Specialist, April 1982.
14. Earlier it was estimated that just meadow fertilization would add \$9,983 to ranch income. The Lower Sheep Creek Seeding was estimated to add \$5,763 to net ranch income (table 16). The sum of these increases in income is \$15,746 which is \$1,728 less than the \$17,474 which is estimated when the two management options are considered together.
15. An estimated 125 head of brood cows (valued at \$400 per head) and seven bulls (valued at \$800 per head) would be purchased over the life of the project.

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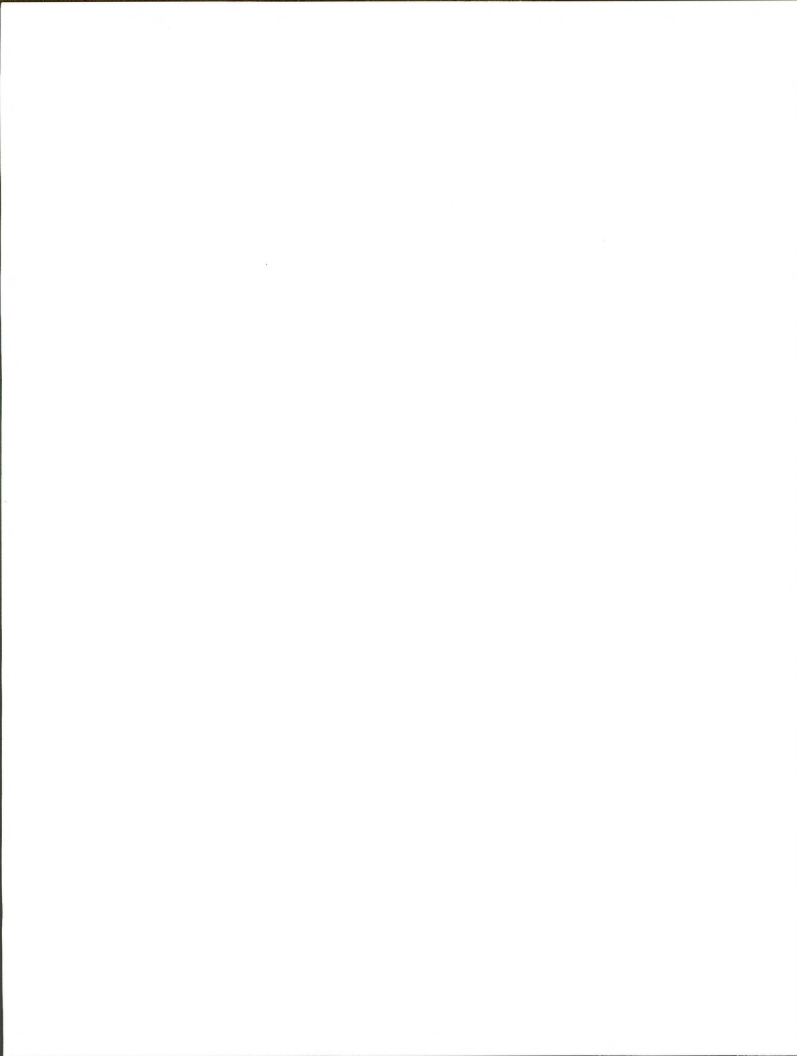
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INTRODUCTION

The Saval Ranching Company is a privately owned enterprise located in northeastern Nevada near Elko. In May 1978, the Saval Ranching Company entered a cooperative agreement with the Bureau of Land Management (BLM) Soil Conservation Service (SCS), United States Forest Service (USFS), University of Nevada-Reno (UNR), and the Agricultural Research Service (ARS) to analyze the effects of livestock grazing management systems. The overall objective of the Saval Ranch Research and Evaluation Study was to evaluate the effects of livestock grazing management systems and necessary range improvement practices on livestock production, vegetation, fish, and wildlife and their habitats, watershed hydrology, water quality, economic factors, and other resource values on the Saval Ranch allotment.

Accomplishments since 1978 include: (1) an Order III soil survey, (2) a delineation of range sites classified to range condition, (3) a vegetation inventory, (4) a cultural resource inventory, (5) collection of baseline data on all resources, (6) an environmental assessment, (7) a coordinated management plan and agreement between the ranch and federal land agencies, and (8) implementation of various range improvements. The management plan included an interim grazing schedule from 1981 through 1983. Full implementation of the management plan began with the 1984 grazing season and included season of use, rest, and deferred grazing treatments.

This paper incorporates data pertaining to livestock production and ranch economics. From these data a profit-maximizing computer

model was developed and used to analyze alternative livestock production schemes for the ranch under the objective of profit maximization. Alternative management options considered included both season-long grazing and optimal production under the grazing system. The benefits and impacts of the grazing system are not known at this time. As such, this report provides a preliminary look at the economics of the Saval grazing system using best estimates of impacts and benefits expected to result from implementation of this system.

"Optimal" livestock production strategies for the alternative management options considered are described. For each management option the question is asked, "What is the 'best' resource management scheme and production strategy if the ranch objective is profit maximization?" We do not purport to have found the ultimate management strategy that the Saval Ranch should follow. An infinite number of livestock management strategies, range improvements, and/or production strategies are possible. We considered only a relevant subset of the infinite set of possibilities. Options considered include the grazing management system outlined in the Saval Coordinated Management Plan (USDI-BLM 1981a) as well as other options considered feasible by the Saval Ranch manager and Saval project researchers. Even though income/cost data, livestock production data, and resource information from the Saval Ranch were used in the analysis, budgets prepared for the various management options do not reflect the income position actually realized by the Saval Ranch. Budgets reflect the 'best' (profit maximizing)

economic position that could be achieved with the specified model parameters for the particular management option considered.

While the analysis is very specific to the Saval Ranch, the paper analyzes the economics of various livestock management options relevant to other western livestock ranching operations. The paper presents a methodological framework using linear programming (LP) and discounting to analyze a wide variety of relevant ranch economic questions. This framework provides examples of how these tools or methods can be used to identify the costs and benefits of alternative livestock management schemes. The natural resources used by the Saval Ranch enterprise are fairly representative of other ranches in the Great Basin. As a result, the analysis could be applied, with some adjustments, to many similar ranches in the area.

The paper is divided into three sections. The first section outlines existing resources and production on the Saval Ranch, the second considers various livestock production strategies under the traditional season-long grazing scheme, and the third compares the optimal production scheme under season-long grazing with optimal production after implementing the grazing system. The primary purpose of the paper is to compare and contrast the economics of these optimal production strategies.

SECTION I

EXISTING RESOURCES AND PRODUCTION ON THE SAVAL RANCH

SAVAL RANCH RESOURCE INVENTORY

This section of the paper describes all forage resources available on the Saval Ranch. Estimated forage production and field acreages are presented. Figure 1 shows the location of the various federal allotments, pastures, and hay fields.

Federal Range Resources

A Soil-Vegetation Inventory Method (SVIM) range survey (USDI-BLM 1981b) was conducted on federally administered lands during 1979. The estimated number of Animal Unit Months (AUM's) and acreage in each pasture are detailed in Table 1. These estimates reflect a sustained-yield level of production that allows the continuation of desired animal and forage production under season-long grazing during an average year.

Carrying capacity varied from a high of approximately two acres per AUM on the BLM Darling Seeding (Figure 2) to a low of 25 acres per AUM on BLM native pastures (Figure 3). Forage production on National Forest native pastures (Figure 4) averaged about 4.5 acres per AUM.

During 1981, 2,430 acres of native range, 52.8 percent of the total pasture acreage, were plowed and seeded in the BLM Lower Sheep Creek Pasture. If it is assumed that the new seeding will be as productive as the Darling Seeding (two acres per AUM), and subtracting 52.8 percent of the previously available 310 AUM's to reflect the AUM's lost from plowing, the carrying capacity of the Lower Sheep Creek Pasture after seeding was estimated to be 1,282

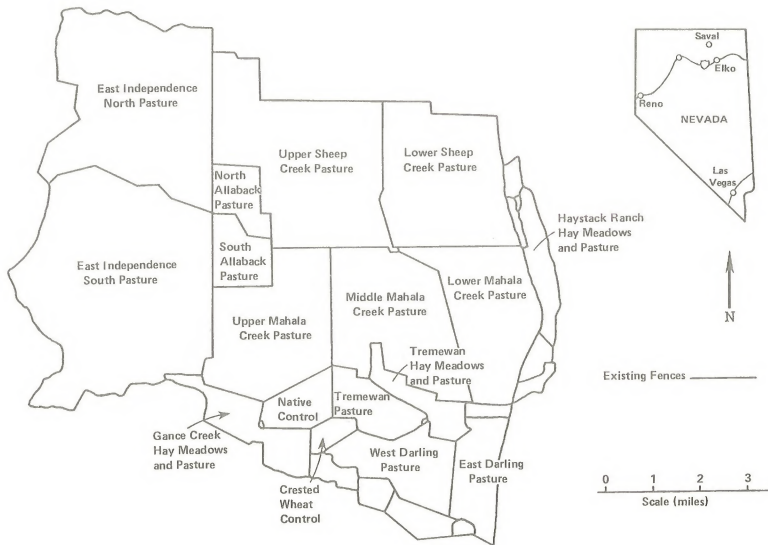


Figure 1. Native and Seeded Rangeland and Hay Meadows on the Saval Allotment.

Table 1. Forage Available for Livestock Production, and Acreages by Pasture on BLM and USFS Allotments, 1981.

Pasture Name	Percent Federal	Acres ^a	AUM's ^b	Acres/AUM
<u>North Allaback (BLM)</u>	100	845	84	10.06
<u>Mahala Creek (BLM)</u>	93			
Upper		3,935	367	10.69
Middle		4,100	237	17.30
Lower		3,435	137	25.07
Native Control ^c		768	52	14.76
		<u>12,228</u>	<u>793</u>	<u>15.42</u>
<u>Sheep Creek (BLM)</u>	95			
Upper		5,900	499	11.82
Lower		4,600	310 (1,282) ^d	14.84 (3.58)
		<u>10,500</u>	<u>809 (1,781)</u>	<u>12.97 (5.90)</u>
<u>Darling Seeding (BLM)</u>	93			
East		1,470	669	2.19
West		1,340	663	2.02
Crested wheatgrass control ^c		370	156	2.37
		<u>3,180</u>	<u>1,488</u>	<u>2.14</u>
<u>East Independence (USFS)</u>	91			
North pasture		6,520	1,420	4.59
South pasture		9,120	2,046	4.46
		<u>15,640</u>	<u>3,466</u>	<u>4.51</u>
TOTAL		42,393	6,640	

^a Acreage were estimated by the Elko District BLM Office.

^b USDA-BLM 1981a.

^c Control pastures will continue to be used under traditional season-long grazing even after implementation of the Saval grazing system. These pastures will provide a comparison for detecting any differences in vegetation responses under season-long grazing and the grazing system. Control pastures were included in the analysis so that the total forage base of the ranch would be considered.

^d Bracketed values reflect the estimated number of AUM's and acres per AUM once the new 2,430 acre Lower Sheep Creek Seeding is available for grazing.



Figure 2. Crested Wheatgrass Seeding on Bureau of Land Management Allotment.



Figure 3. Sagebrush-grass Vegetation Type on Bureau of Land Management Allotment.



Figure 4. Sagebrush-grass, Mountain brush, and Aspen Vegetation Types on U.S. Forest Service Allotment.

AUM's. Subsequent analysis of the seeding indicates that this estimated level may be somewhat optimistic. Back et al. (1984) estimated total stocking rate for the Lower Sheep Creek Pasture to be 955 AUM's based upon BLM evaluation of the seeding during August 1983. Success of the stand may improve with time and proper management.

Private Rangeland, Hay Meadows, and Pastures

Privately owned rangelands, hay meadows, and irrigated pastures are generally located along Gance Creek, Mahala Creek, and the north fork of the Humboldt River (Figure 1). The Tremewan Seeding and the South Allaback Pasture are also owned by the Saval Ranch. In addition, federal allotments include small inter-mingled parcels of privately owned rangeland. For example, the Mahala Creek Pastures contain seven percent private land (Table 1).

An estimate of the carrying capacity of all private hay fields, pastures, and rangelands was also made using SVIM (Table 2). Field acreages were estimated from a 1975 Soil Conservation Service photo of the Saval Ranch (USDA-SCS 1975). About 1,130 acres of native hay meadows occur on the Saval Unit with an additional 578 acres on the Haystack Unit (USDA-SCS 1975) (Figure 5).

Part of the meadows are not cut for hay each year because in some years irrigation water is too limited to provide a harvestable crop. As a result, hay yield varies considerably from year to year. For example, hay yield was estimated to be nearly 1,600 tons (.93 ton per acre) in 1979.¹ This compares with only 900 tons (.53 ton per acre) in 1981.² The SVIM inventory estimates for hay meadows

Table 2. Forage Production and Acreage Estimates of Privately Owned Rangelands, Hay Meadows, and Pastures under Fence, 1981.

Pasture Name	Acres	AUM's	Average Acres per AUM
Tremewan Seeding	1,003	444	2.26
South Allaback	995	214	4.65
Saval rangeland and pasture	2,190	1,081	2.03
Haystack rangeland and pasture	816	96	8.50
Saval hayland and aftermath	1,130	141	8.01
Haystack hayland and aftermath	578	72	8.01
TOTAL	6,712	2,048	

Sources: United States Department of the Interior, Bureau of Land Management (USDI-BLM), Elko District Office, 1979 SVIM computer printouts summarizing forage production on privately owned pastures and rangeland.



Figure 5. Hay Meadow on Private Land.

show an average yield of .85 ton of hay and .125 AUM's of aftermath per acre.³ These SVIM estimates were taken to reflect the average hay crop under current management practices with the realization that this level of production may not be available every year.

Hay yields on the Saval Ranch are considerably less than those obtained on other Elko County ranches which average at least one ton per acre. Some well watered fields along the Ruby Mountains average nearly two tons per acre.⁴ Hay production has been identified as a problem on the Saval Ranch; quality winter feed currently is the most limiting seasonal forage resource. It is not unusual for the ranch to run out of hay by spring turn-out time.

Quality of hay produced on the Saval is within the range of values reported for other Elko County ranches,⁵ however, the species composition of haylands includes many less desirable species. Sedges and wiregrass which presently dominate irrigated land are less productive, palatable, and desirable than grasses.

LIVESTOCK INVENTORY

An estimated 1,210 mature cows and 100 additional first-calf-heifers were maintained by the Saval Ranch in March 1982.² In July 1982, 156 head of cull cows were sold--the first major culling of cows in nearly two years. A total of 1,134 brood cows (including first-calf-heifers) were estimated as the September 1982 herd size. Herd size has been reduced by nearly half since that time.

Table 3 summarizes average livestock production parameters from 1980 through 1982. A 70 percent wean crop was estimated (USDA-BLM 1981a). This weaning percentage includes an estimated 5

Table 3. Average Livestock Inventory and Production Statistics for the Saval Ranch, 1980 through 1982.

Description	Amount	Units
Number of brood cows ^a	1,134	Head
Calf crop ^b	75	Percent
Calf death loss	5	Percent
Cow and bull death loss	3	Percent
Yearling death loss	3	Percent
Average steer calf selling weight ^c	351	Pounds
Average heifer calf selling weight ^c	345	Pounds
Average steer yearling selling weight ^d	671	Pounds
Replacement rate	20	Percent
Bulls per 100 cows	6	Percent
Number of horses	16	Head

^aIncludes two-year-old replacement heifers. Reflects the September 1982 herd estimate.

^bEstimated by dividing the number of calves born in the spring by the number of cows left in the herd after replacement and culling.

^cOctober weight included a three percent sales shrinkage.

^dEstimated September weight includes a three percent sales shrinkage.

percent calf death loss. The 1982 weaning percentage was estimated to be 59 percent when only the number of calves weaned were counted (Winer and Speth 1983). An extended calving season resulted in 294 calves too young for weaning in October. If percent calf crop is calculated to include these young animals, the 1982 calf crop would increase to 85 percent.

The Saval Ranch was operated as a cow-calf operation; calves were weaned and sold in October. Average calf selling weights during 1980 were estimated at 384 pounds for steer calves and 373 pounds for heifer calves (Winer and Speth 1983). During October 1981, the estimate was 339 pounds for steer calves and 338 pounds for heifer calves. The average calf selling weight over both years was 351 pounds for steer calves and 345 pounds for heifer calves. Weaning weights reported for 1982 were considerably higher at 433 pounds for steer calves and 423 pounds for heifer calves (Winer and Speth 1983). However in 1982, only calves born during the month of March were used in the study group and therefore, these weaning weights do not reflect a cross section of the total Saval calf crop born over a much longer time period. They do, however, provide an indication of the advantages of a shortened calving period.

Using a conservative estimate of average rate of gain of one pound per day, steer calves kept on the ranch could be sold as yearlings the following September at an average selling weight of 671 pounds. These weights are similar to estimates presented in the Saval Coordinated Management Plan (USDI-BLM 1981a).

Table 4. Estimated Costs for Various Production Activities on the Saval Ranch.

Cost Activities	Activity Description	Cost/Unit
Grass hay production	Growing and harvesting one acre of grass hay.	\$30.06/acre
Irrigated pasture grazing	Growing one acre of irrigated pasture	10.02/acre
Deeded range grazing	Use of one AUM of ranch owned private range.	.00/AUM
Federal grazing	Use of one AUM of federal range	2.02/AUM ^b
Aftermath grazing	Use of one AUM of ranch owned aftermath.	.00/AUM
Buy alfalfa	Purchase of one ton of alfalfa hay.	68.00/AUM
Non-feed costs	Non-feed expenses (e.g. veterinary, gas, repairs) of livestock production on a per cow basis.	87.81/cow ^c
TOTAL VARIABLE COSTS	Total feed and non-feed costs listed on a per cow basis.	180.90/cow

^aVariable costs of grazing private resources are included under non-feed costs.

^bReflects the 1979-81 average of federal grazing fees but does not include the non-fee costs of grazing these areas as estimated by Torell et al. (in press).

^cThe specific costs included are more thoroughly specified in the various "Ranch Income Statements" presented in the next section of this report. In order to make the per cow variable cost figure of the Saval Ranch directly comparable with values presented by Myer and Hackett (1981) for "representative" Elko County ranches, "utilities" have been included as a variable cost in the above figure, whereas, they are considered as a fixed cost in the rest of the analysis.

COSTS OF PRODUCTION

Estimated annual livestock production costs (Table 4) were derived from two sources. First, production costs and returns were estimated specifically from the Saval Ranch in 1979 and 1980.^{1,6} Second, information presented by Myer and Hackett (1981) for representative Elko County ranches was also used for comparison. Appropriate cost indices were used to put all costs on a 1980 basis.

Variable costs of production per cow for the Saval Ranch are estimated to be \$181. This compares with the \$173 estimated by Myer and Hackett (1981) for other representative cow-calf operations in Elko County. Given the extreme variability among production practices of livestock ranches, there appears to be no meaningful difference between variable production costs on the Saval Ranch and other Elko County ranches. What does appear to vary markedly are livestock production levels -- calf crop and weaning weights. The estimated average Saval calf wean crop of 70 percent is 10 percent lower than the weaning percentage reported for other representative Elko County ranches (Myer and Hackett, 1981). A similar comparison of selling weights shows that 1980-81 average steer calf weights on the Saval were approximately 44 pounds lighter and heifer calf selling weights were approximately 10 pounds lighter than those reported by Myer and Hackett (1981). The lower calf crop and lower selling weights result in lower than average gross income per cow for the Saval Ranch.

Table 5 gives beef prices used in analyzing various economic management options. Income/cost information for the Saval Ranch is

more thoroughly specified in the various ranch income statements for the management options presented in the next section. Beef prices used were taken to reflect long term expected prices.

Table 5. Beef Prices Used in Analyzing Various Management Options for the Saval Ranch.

Return Activity	Activity Description	Price/cwt ^a
Sell calves	The gross income from selling one cwt of calf production at the 1979-81 three year average price. When the calf/yearling weight equals:	
	300-400 pounds	
	Steers	\$80.05
	Heifers	68.27
	400-500 pounds	
	Steers	80.05
	Heifers	66.85
	500-600 pounds	
	Steers	75.38
	Heifers	64.12
	600-700 pounds	
	Steers	71.38
	Heifers	62.76
	700-800 pounds	
	Steers	68.92
	Heifers	62.76
Sell cull cows	The gross income from selling one cwt of cull cows.	44.01
Sell cull bulls	The gross income from selling one cwt of cull bulls.	59.43

^aAll livestock sale prices reflect the 1979-81 average price received at California Feedlot and Range Sales by weight category (USDA Market News Service, 1983).

SECTION II

OPTIMAL LIVESTOCK PRODUCTION
UNDER TRADITIONAL SEASON-LONG GRAZING

The estimated costs of production, grazing/hay resources, "typical" livestock production practices, and production levels obtained on the Saval Ranch, as outlined in the previous section, were used to develop a profit maximizing linear programming (LP) model. The computer based model allocates resources (e.g. hay, grazing forage) to livestock to maximize ranch income (return over variable costs). The model captures the interrelationship between classes of resources, seasonal livestock forage requirements, and seasonal forage availability. Total seasonal grazing resources are considered in relation to the optimal (profit maximizing) management strategy. Beef prices, costs of production, range improvements, and "typical" livestock production levels are considered explicitly. Thus, the model provides a tool for estimating how range improvements and implementation of the Saval Ranch grazing management system would affect optimal production levels and net ranch income. The model can also be used to analyze the economics of alternative production schemes of particular interest to Saval Ranch decision makers.

The following management options were considered in the LP analysis:

Optimal livestock production with 1981 forage resources as estimated by SVIM (Tables 1 and 2) and under the traditional season-long grazing pattern.

- cow-calf operation (Option 1)
- cow-calf/yearling operation (Option 2)

Optimal livestock production with calf crop and weanings weights increased to average levels reported for Elko County by Myer and Hackett (1981) (Option 3).

Optimal livestock production with increased calf crop and weaning weights, and the addition of the Lower Sheep Creek Seeding (Option 4).

Optimal livestock production with increased calf crop and weaning weights, and fertilization of 1/3 of available hayland (Option 5).

Optimal livestock production with increased calf crop and weaning weights, fertilization of 1/3 of available hayland, and addition of the Lower Sheep Creek Seeding (Option 6).

Optimal livestock production under the Saval Ranch grazing system (Option 7).

The LP optimum management strategy outputs for each option were entered into a microcomputer program which was designed to automatically generate a ranch income statement to match the LP results. These final outputs are presented in this report. Note that all numbers in these charts may not always "add up" due to rounding errors.

OPTIMAL HERD SIZE WITH 1981 RESOURCES

The current cow-calf operation of the Saval Ranch is very similar to other cow-calf operations in northern Nevada. Cows are bred to calve in the spring (March and April). Bulls remain with the cows throughout the grazing season. Calves are weaned and sold in October. All cows are turned out on rangeland about the middle of April with the total herd depending heavily upon federal range for spring, summer, and fall forage requirements.

Options 1 and 2 consider this basic scheme with the 1981 forage resource base as presented in Tables 1 and 2. In addition, estimated livestock production levels obtained on the Saval during 1980-82, as presented in Table 3, were used in the analysis. Given these production parameters, specified beef prices, and costs, and available forage resources, the LP model chooses the production

strategy that maximizes profit. Estimates of the profit maximizing herd size, production levels, net returns, and optimal resource use were generated.

Cow-calf Operation (Option 1)

When the LP model was allowed to pick optimal herd size as a cow-calf operation, given 1981 grazing resources, the profit maximizing scale of operation would be to maintain a cow herd of 821 head. This number of brood cows and herd complement (e.g. bulls, replacements, weaner calves) would use all available range forage under sustained yield. A total of 1,683 acres (1,430 tons) of hay would be harvested for winter feed with the remaining 25 acres of hayland grazed as irrigated pasture. No additional hay would be purchased.

Livestock sales are estimated to be \$177,114 when 1979-81 three-year average prices are considered (Table 6). Total feed costs are estimated to be \$63,068, an average of \$76.82 per cow. This assumes the Saval Ranch produces just the right amount of hay and knows how to optimally utilize forage resources.

Subtracting estimated total variable costs of production of \$135,160 results in a return over variable costs of \$41,955 (\$177,114 - \$135,160). When fixed costs are subtracted, the return to land and capital is estimated to be minus \$25,979 (\$41,955 - \$67,934).⁷

Cow-calf/yearling Operation (Option 2)

This option analyzes the economics of switching the current cow-calf operation to a cow-calf/yearling operation with the 1981

Table 6. Ranch Income Statement for Cow-Calf Operation Under Season-Long Grazing, Optimal Herd Size (Option 1).

=====			
-----INCOME-----			
	\$/CWT	LBS.	TOTAL
287 STEER CALVES	80.05	351	80738
123 HEIFER CALVES	68.27	345	29006
140 CULL COWS	44.01	950	58354
11 CULL BULLS	59.43	1400	9017
GROSS INCOME			177114
=====			
----- PRODUCTION COSTS -----			
	\$/UNIT		TOTAL
1. FEED COSTS			
6054 AUMS FEO. FORAGE	2.02		12230
1683 ACRES RAISED HAY			
LABOR	16.73		28154
FUEL	6.77		11393
REPAIRS	4.16		7001
SUPPLIES	2.40		4039
SUBTOTAL	30.06		50586
0 TON PURCHASED HAY	68.00		0
25 ACRES IRRIG. PASTURE			
LABOR	8.64		218
FUEL	0.68		17
FENCING	0.21		5
REPAIRS	0.49		12
SUBTOTAL	10.02		252
TOTAL FEED COSTS			63068
=====			
	\$/COW		TOTAL
II. NON-FEED COSTS			
821 HEAD OF COWS			
LABOR	50.10		41132
VEHICLE REPAIR	5.00		4105
GAS & OIL	12.67		10402
GENERAL SUPPLIES	3.93		3227
GENERAL MAINTENCE	2.79		2291
OFFICE EXPENSES	0.18		148
ACCOUNTING	0.83		681
VETERINARY & MED.	5.28		4335
FREIGHT & HAULING	2.06		1691
BRAND INSPECTION	0.34		279
SALT & MINERALS	3.30		2709
MARKETING	1.33		1092
SUBTOTAL	87.81		72092
TOTAL NONFEED COSTS			72092
TOTAL VARIABLE COSTS			135160
=====			
----- III. FIXED COSTS -----			
TELEPHONE			1865
UTILITIES			13362
INSURANCE			8678
TAXES			6273
DEPRECIATION			37756
TOTAL FIXED COSTS			67934
=====			
----- IV. RETURNS -----			
RETURN OVER VARIABLE COSTS			41955
RETURN TO LAND & CAPITAL			-25979
=====			

forage resource base. The same type of cow-calf production strategy is considered but all steer calves are sold as yearlings rather than as weaners. The following assumptions were made concerning all yearling options (unless otherwise stated):

1. The sale weight of yearling steers will average 671 pounds. This is based on a very conservative one pound average gain per day from weaning (October of previous year) until sale at about one and a half years of age.
2. A yearling death loss of 3 percent.
3. Yearlings will require an average of 14.5 pounds of hay per day throughout the 121 day winter feeding period.
4. In addition to hay, steer yearlings will be fed one pound per day per head of a high energy grain pellet during the winter feeding period. These pellets will cost \$200 per ton delivered to the ranch. This amounts to \$12.10 per head for the winter feeding season.
5. During the grazing season, yearlings are considered as a full Animal Unit (AU) (as compared with the typical 0.6 AU to 0.8 AU generally considered). This corresponds to pricing and stocking strategies used by the federal agencies upon whose land yearlings would generally graze.
6. Each steer carried over for sale as a yearling will require slightly less than seven hours of labor (e.g., feeding, checking herding) over and above other ranch labor requirements. This labor expense will amount to \$35.79 per head.

In addition to the above explicit assumptions, several implicit assumptions were also made. These include the fact that yearlings can and are raised in Elko County and that the Saval range can provide adequate nutrition for the assumed one pound of gain per day. If any one of these assumptions were not true for the Saval Ranch, the analysis would be unsound, however, the authors believe these assumptions are conservative and probably represent a lower limit for expected returns.

Optimal herd size as a cow-calf/yearling operation is estimated at 689 head of brood cows. All forage would be fully utilized. Total livestock sales are estimated to be \$192,917 (Table 7).

The ranch income statement presented for this option includes costs for labor, range forage and hay and grain pellets needed for carrying over all yearling steers. These expenses are estimated to be \$21,177 or \$90.50 per yearling steer sold the following fall.

On a per cow basis, costs would remain about the same with total variable costs of \$134,205 for the cow-calf/yearling option as compared to \$135,160 for the cow-calf option. Gross income, however, would be \$21,803 higher under the yearling option.

While net returns are still estimated to be negative under a cow-calf/yearling option, returns are considerably higher. Return to land and capital increases from a negative \$25,979 for management as a cow-calf operation (Option 1) to a negative \$9,222 when all steer calves are held over for sale as yearlings (Option 2). This represents an increase in ranch returns of \$16,757 by switching to a cow-calf/yearling operation. These same general results have also been reported by other researchers (Hewlett and Workman 1978, Kearl 1972) for ranches in the Great Basin.

The positive economic benefit outlined above would be true for a "typical year" once the Saval Ranch had made the switch to a cow-calf/yearling operation. However, the first year of the switch may be financially difficult. Whereas the Saval would normally receive all income in the fall when calves and cull animals are sold, the first year of the switch to a cow-calf/yearling operation

Table 7. Ranch Income Statement for Cow-Calf/Yearling Operation Under Season-Long Grazing, Optimal Herd Size (Option 2).

-----INCOME-----			
	\$/CWT	LBS.	TOTAL
234 STEER YEARLINGS	71.38	671	112036
103 HEIFER CALVES	68.27	345	24342
117 CULL COWS	44.01	950	48971
9 CULL BULLS	59.43	1400	7567
GROSS INCOME			192917
----- PRODUCTION COSTS -----			
I. FEED COSTS	\$/UNIT		TOTAL
6054 AUMS FED. FORAGE	2.02		12230
1655 ACRES RAISED HAY			
LABOR	16.73		27681
FUEL	6.77		11202
REPAIRS	4.16		6883
SUPPLIES	2.40		3971
SUBTOTAL	30.06		49737
0 TON PURCHASED HAY	68.00		0
53 ACRES IRRIG. PASTURE			
LABOR	8.64		461
FUEL	0.68		36
FENCING	0.21		11
REPAIRS	0.49		26
SUBTOTAL	10.02		535
TOTAL FEED COSTS			62502
II. NON-FEED COSTS	\$/COW		TOTAL
689 HEAD OF COWS			
LABOR	50.10		34519
VEHICLE REPAIR	5.00		3445
GAS & OIL	12.67		8730
GENERAL SUPPLIES	3.93		2708
GENERAL MAINTENANCE	2.79		1922
OFFICE EXPENSES	0.18		124
ACCOUNTING	0.83		572
VETERINARY & MED.	5.28		3638
FREIGHT & HAULING	2.06		1419
BRAND INSPECTION	0.34		234
SALT & MINERALS	3.30		2274
MARKETING	1.33		916
SUBTOTAL	87.81		60501
234 HEAD OF YEARLINGS			
LABOR	35.79		8372
GRAIN PELLETS	12.10		2830
SUBTOTAL	47.89		11202
TOTAL NONFEED COSTS			71703
TOTAL VARIABLE COSTS			134205
III. FIXED COSTS			
TELEPHONE			1865
UTILITIES			13362
INSURANCE			8678
TAXES			6273
DEPRECIATION			37756
TOTAL FIXED COSTS			67934
IV. RETURNS			
RETURN OVER VARIABLE COSTS			58712
RETURN TO LAND & CAPITAL			-9222

would mean foregoing income from steer calf sales until yearlings are sold the following September. This would require a short-term loan to carry the ranch into a yearling operation.

A major factor determining the profitability of a cow-calf operation versus a cow-yearling operation is the differentials in beef prices. In the above analysis, a three-year average (1979-81) of beef prices was considered. One immediate question that can be asked is whether the apparently better economic outlook of a cow-calf/yearling operation arises simply because of the specific beef prices used. To analyze this possibility, the LP model was run at several alternative beef price situations. The average price received at California feed lot and range sales (USDA Market News Service 1983) during 1977, 1979, 1981, and 1982 were considered as alternative beef price situations (Table 8). The 1977 price situation was chosen to reflect a very low price level. During 1979, beef prices were at an all time high; 1981 and 1982 average prices reflect the current price situation faced by the Saval Ranch. This set of alternative prices represents a range in steer calf price from \$.42 per pound in 1977 to \$.91 per pound in 1979. The results indicate that the choice between a cow-calf or a cow-calf/yearling operation on the Saval is quite insensitive to relative beef prices--at least over the range of price situations considered. Under the very low 1977 prices, model results indicate that the "optimal" production strategy would be to get out of the livestock business. Beef prices are too low to cover variable costs and positive returns over variable costs would not be possible. Under 1979, 1981, and 1982 price situations, the model

Table 8. Alternative Beef Price Situations Considered in Analyzing the Relative Profitability of a Cow-Calf Versus a Cow-Calf/Yearling Operation on the Saval Ranch.

Livestock Class	1979-1981	1977	1979	1981	1982
	3-Year Average				
	(\$/cwt)	(\$/cwt)	(\$/cwt)	(\$/cwt)	(\$/cwt)
Steer calves, 300-400 pounds	80.05	42.11	90.98	69.67	65.54
Heifer calves, 300-400 pounds	68.27	33.02	76.94	56.30	54.37
Feeder steers, 600-700 pounds	71.38	39.11	78.21	64.15	62.46
Slaughter cows, cutter 1-2	44.01	22.73	47.50	40.36	36.65
Slaughter bulls, yield grade 1	59.43	33.28	65.42	55.24	50.27

Source: USDA Market News Service 1982.

results indicate the same optimal production strategy as outlined in Option 2. None of the price situations indicated a higher level of ranch income from a cow-calf operation. The model results appear quite conclusive, then, that a cow-calf/yearling operation would result in higher net returns with the assumed selling weights, costs, and seasonal forage restrictions included in the analysis.

OPTIMAL PRODUCTION WITH IMPROVED LIVESTOCK PRODUCTION PARAMETERS

Cow-Calf/Yearling (Option 3)

As indicated earlier, livestock production parameters estimated for the Saval Ranch are lower than values reported for other "representative" Elko County ranches by Myer and Hackett (1981). This option considers the question: "What would be the optimal production strategy and ranch economic situation if key livestock production parameters on the Saval could be increased to levels realized on 'representative' Elko County ranches?". This option considers the economic benefits of increasing weaning percentage by 10 percent, from 70 percent to 80 percent; increasing steer selling weights by 44 pounds, from 671 pounds to 715 pounds for yearlings, and from 351 pounds to 395 pounds for steer calves; and adding 10 pounds to the 345 pounds estimated as the 1980-81 average selling weight of heifer calves. It was assumed this could be accomplished through better breeding management and herd health with no long-term increase in ranch expenses or labor input.

With these increases in key livestock production parameters, optimal herd size is estimated to be 670 brood cows. This

represents a slight decrease in herd size from the 689 head optimal herd size estimated under Option 2. This reduction would be necessary to maintain forage balance with the additional yearling steers that would be on the ranch because of the increased calf crop.

As indicated in Table 9, a significant increase in ranch income results from increases in key livestock production parameters. Compared to optimal production with existing livestock production parameters (Option 2), the economic benefit of reproduction and weight gain performance is evident. Gross livestock sales would increase by 14 percent from \$192,917 to \$220,130 (Table 9). Total variable costs would decline slightly because of the decrease in cow herd size. Net return to land and capital would increase from minus \$9,222 to positive \$18,648. This \$27,870 increase in ranch returns resulting from improved livestock performance indicates the importance of key production parameters. Torell et al. (1982) and Kearl (1972) have also indicated the importance of good livestock performance in maintaining a viable ranching unit.

ECONOMICS OF RANGE IMPROVEMENTS

The analysis, thus far, has considered various management options under "existing resources". However, during the summers of 1981 and 1982 several range improvement projects were implemented on the Saval Ranch. These improvements should soon increase the forage base of the ranch. The following section considers the cost of improvements as well as estimated benefits to livestock

Table 9. Ranch Income Statement for Livestock Production with Improved Calf Crop and Calf/Yearling Selling Weights, Optimal Herd Size (Option 3).

-----INCOME-----			
	\$/CMT	LBS.	TOTAL
260 STEER YEARLINGS	71.38	715	132675
134 HEIFER CALVES	68.27	355	32476
114 CULL COWS	44.01	950	47621
9 CULL BULLS	59.43	1400	7358
GROSS INCOME			220130
----- PRODUCTION COSTS -----			
I. FEED COSTS	\$/UNIT		TOTAL
6054 AUMS FEO. FORAGE	2.02		12230
1643 ACRES RAISED HAY			
LABOR	16.73		27484
FUEL	6.77		11122
REPAIRS	4.16		6834
SUPPLIES	2.40		3943
SUBTOTAL	30.06		49383
0 TON PURCHASED HAY	68.00		0
65 ACRES IRRIG. PASTURE			
LABOR	8.64		563
FUEL	0.68		44
FENCING	0.21		14
REPAIRS	0.49		32
SUBTOTAL	10.02		653
TOTAL FEEO COSTS			62266
II. NON-FEEO COSTS	\$/COW		TOTAL
670 HEAD OF COWS			
LABOR	50.10		33567
VEHICLE REPAIR	5.00		3350
GAS & OIL	12.67		8489
GENERAL SUPPLIES	3.93		2633
GENERAL MAINTENANCE	2.79		1869
OFFICE EXPENSES	0.18		121
ACCOUNTING	0.83		556
VETERINARY & MED.	5.28		3538
FREIGHT & HAULING	2.06		1380
BRAND INSPECTION	0.34		228
SALT & MINERALS	3.30		2211
MARKETING	1.33		891
SUBTOTAL	87.81		58833
260 HEAD OF YEARLINGS	\$/HEAD		
LABOR	35.79		9304
GRAIN PELLETS	12.10		3146
SUBTOTAL	47.89		12449
TOTAL NONFEEO COSTS			71282
TOTAL VARIABLE COSTS			133548
III. FIXED COSTS			
TELEPHONE			1865
UTILITIES			13662
INSURANCE			8678
TAXES			6273
DEPRECIATION			37756
TOTAL FIXED COSTS			67934
IV. RETURNS			
RETURN OVER VARIABLE COSTS			86582
RETURN TO LAND & CAPITAL			18648

production of the Lower Sheep Creek Seeding grazed under traditional season-long grazing patterns. Other new and proposed improvements, including fences and water developments, are considered to be a part of the proposed grazing system and economic benefits of these improvements will be discussed with the grazing system in Section III. The costs of all recently implemented improvements as well as proposed improvements are described below.

Range Improvements Implemented During 1981 and 1982

Range improvements implemented by BLM included 10.5 miles of new fence, four cattle guards, and the plowing and seeding of 2,430 acres in the Lower Sheep Creek Pasture. One enclosure of about 40 acres was included in the project. This enclosure will be used to evaluate vegetation succession patterns, watershed, and wildlife habitat conditions under a no-grazing situation as compared to grazed areas. The USFS rehabilitated six reservoirs on BLM land, four that are in the Darling Seeding, one within the Lower Sheep Creek Pasture, and one in the Native Control Pasture. During June 1983, four additional cattle guards funded by the BLM were installed by a private contractor.

Forest Service improvements on the East Independence Pastures during 1982 included nine water troughs and nine pit tanks. Placement of the troughs was done through a private contractor; pit tank construction was performed by the USFS. Additionally, approximately four miles of division fence was reconstructed by a private contractor.

Although implementation costs were incurred by the BLM and USFS, maintenance is the responsibility of the Saval Ranch.

Costs of Implemented Range Improvements

The costs of all range improvements implemented on the Saval to date were estimated from information supplied by BLM and USFS offices in Elko. None of the costs include BLM and USFS overhead expenses for environmental assessment, contract preparation, or supervision because it was assumed these costs would be incurred even if these improvements had not been installed.

In budgeting costs of improvements, actual contract and material costs were used where appropriate. These costs were supplemented from other sources when either the actual costs were not available or were unrealistically high when compared with other similar projects.

Fence Construction. Table 10 outlines the estimated costs for the 10.5 miles of fence built on the Saval during the summer of 1981. All costs reflect actual expenses. The total estimated cost is \$31,110 or \$2,963 per mile. This per mile cost is about \$384 higher than guideline values presented by Sonnemann et al. (1981) for building a four-strand barbed wire fence in northern Nevada during 1981. The major difference is in the estimated labor expense.

Table 11 outlines the cost of specific fences needed to implement the grazing system. Figure 6 shows the location of these fences. The price of four cattle guards installed during June 1983 was estimated to be \$10,400 or \$2,600 each. This cost was slightly higher than cattle guards installed during April 1982.

Plowing and Seeding. Plowing of the Lower Sheep Creek Seeding was contracted at \$57 per hour for tractor and operator. The

Table 10. Fence Construction Costs as Contracted on the Saval Ranch, 1981.

Expense Category	Number of Units	Cost per unit	Total for 10.5 Mile	Cost per Mile
1. Contract Labor			\$19,700	\$1,876
2. Materials				
Steel posts	2,418 posts	\$ 2.38	5,755	548
Barbwire	172 rolls	29.20	5,022	478
Smooth wire	5 rolls	26.19	131	13
Fence stays	24 bundles	15.90	382	36
Fence clips			120	12
Corner posts	supplied by contractor		--	--
Subtotal Labor			\$19,700	\$1,876
Subtotal Materials			11,410	1,087
TOTAL			\$31,110	\$2,963

Table 11. Fence Construction Costs for Specific Pastures and Fences.

Fence Description	Number of Miles	Fence Number from Figure 2	Total Cost
Darling Seeding Division Cattle guard (12 ft.)	1.4	6	\$ 4,148 <u>1,957</u>
SUBTOTAL			6,105
Darling Seeding Control Cattle guard (14 ft.)	0.6	4	1,178 <u>2,157</u>
SUBTOTAL			3,935
Mahala Native Control Cattle guard (14 ft.)	1.6	3	4,741 <u>2,157</u>
SUBTOTAL			6,898
Mahala Creek #1	3.2	1	9,481
Mahala Creek #2	2.8	2	8,296
Cattle Guard (14 ft.)			<u>2,157</u>
SUBTOTAL			11,638
Mahala Creek vegetation and wildlife exclosure	0.5		1,481
Reservoir Field	0.4	5	1,185
SUBTOTAL - Fencing	10 5		31,110
SUBTOTAL - Cattle Guards			<u>8,428</u>
TOTAL			\$39,538

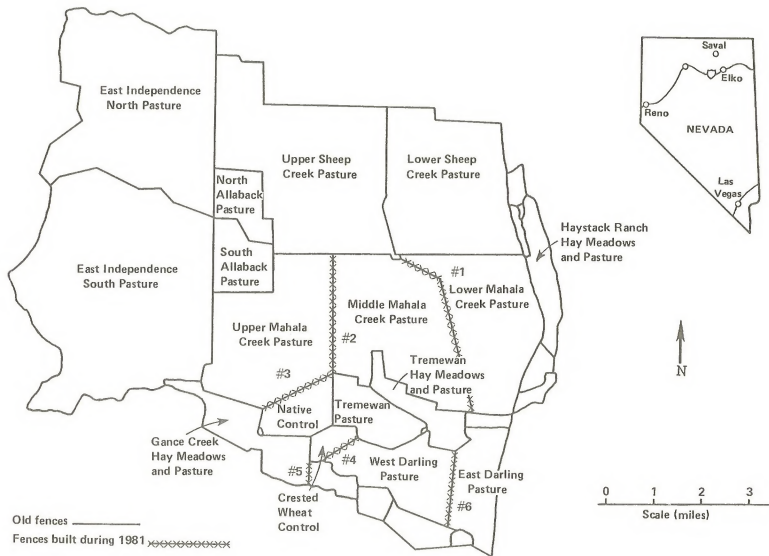


Figure 6. New Fences Constructed during 1981 on Saval Allotment.

contractor plowed approximately 1,800 acres of the total 2,430 acres--the rest was plowed by BLM personnel. Costs incurred by the BLM in seeding the Lower Sheep Creek Pasture were judged to be unreasonably high because crawler tractors used by the BLM had exceptionally high repairs and down-time. The average cost per acre for the acreages plowed by the contractor was \$12.45. This value was used in cost estimates for the total 2,430 acres plowed (Table 12). A cost of \$2.50 per acre in plow repair, as estimated by Sonnemann et al. (1981), was also included. Repairs, fuel, and lubricants for the tractor were paid for by the contractor.

BLM personnel performed all range seeding, however, because of inefficiencies described above, actual expenses as incurred by the BLM were not included in the analysis. Instead, a contract rate of \$5 per acre was used. This rate was estimated from a contractor near Wells, Nevada,⁸ and also corresponds closely to that presented by Sonnemann et al. (1981).

Seed costs were taken from a 1981 BLM seed procurement memorandum.⁹ Ladak Alfalfa was not included on the memo and its cost was estimated from Jacklin Seed Company.¹⁰

Other expenses incurred in plowing and seeding the Lower Sheep Creek Pasture include \$0.35 per acre for transport of plows and seeders from Vale, Oregon, and \$0.80 per acre for non-use of the 310 AUM's that were estimated to be available before seeding the pasture (USDI-BLM 1981a). The one year non-use of forage is valued at the average rate per head for pasturing cattle on nonirrigated private grazing lands in Nevada, \$5.70 per AUM (USDA-SRS, 1982).

The total estimated cost of plowing and seeding the Lower

Table 12. Plowing and Seeding Costs for Lower Sheep Creek Seeding.

Expense Category	Total Cost for 2,430 Acres	Cost per Acre
1. Plowing		
Contract plowing	\$30,254	\$12.45
Plow repair	6,318	2.60
Subtotal Plowing	36,572	15.05
2. Seeding		
Contract seeding	12,150	5.00
Seeder repair	875	0.36
Seed: per acre seeding rates		
5 lbs. Crested Wheatgrass @ \$.68	8,262	3.40
2 lbs. Pubescent Wheatgrass @ \$1.47	7,144	2.94
2 lbs. Russian Wildrye @ \$.85	4,131	1.70
0.5 lbs. Ladak Alfalfa @ \$1.14	1,409	0.58
0.5 lbs. Small Burnett @ \$3.55	4,325	1.78
1 lb. Sweet Clover @ \$.30	729	0.30
Subtotal Seeding	39,025	16.06
3. General Expenses		
Transport of plow and seeder from Vale, Oregon	840	.35
Non-use of range (310 AUMs \$5.70/AUM x 1 yr).	1,767	.73
Subtotal General	2,607	1.08
TOTAL	\$78,204	\$32.18

Sheep Creek Pasture was \$78,204 or \$32.18 per acre treated. This per acre cost corresponds closely to the \$34.07 that would be estimated using the seeding guideline values presented by Sonnemann et al. (1981) and the seed costs presented here.

Reservoir Rehabilitation. USFS personnel spent approximately 10 days at a cost of \$400 per day, for a total cost of \$4,000, in cleaning and deepening six reservoirs.

Water Troughs. The estimated cost of placing nine water troughs on East Independence Pastures totaled \$13,428. Each trough cost \$660, plus \$152 in USFS labor and \$680 in contract labor for installation, for a total cost of \$1,492 per trough.

Pit Tanks. The estimated cost per pit tank installed by USFS was \$651 or \$5,859 for all nine tanks.

Fence Reconstruction. The reconstruction of approximately four miles of USFS division fence cost an estimated \$6,265 in labor and \$4,000 in materials (\$2,566 per mile).

Additional Proposed Range Improvements

The original list of range improvements for Saval allotments included many that will probably not be implemented. Failure to implement all proposed improvements is the result of cost, perceived lack of need, and lack of low interest financing for the ranch. From the original list of proposed improvements (USDI-BLM, 1981a) only those considered most likely to be implemented are considered in the economic analysis of the grazing system.¹¹ Table 13 summarizes all improvements implemented to date and additional improvements which could be implemented.

Table 13. A Summary of Implemented and Proposed Range Improvements on Saval Allotments

Improvement	Units	Total Cost	Maintenance Responsibility	Estimated ^d
				Annual Maintenance Cost
<u>1981 Improvements</u>				
New fence construction	7.8 miles ^b	\$ 23,111	Permittee	\$ 231
Lower Sheep Creek Seeding	2,430 acre	78,204	BLM	782
Reservoir rehabilitation	6 each	4,000	BLM	40
		\$105,315		\$1,053
<u>1982 Improvements</u>				
Cattle guards	2 each ^b	4,114	BLM	41
Water troughs	9 each	13,428	Permittee	269
Pit tanks	9 each	5,859	Permittee	59
Fence reconstruction	4 miles	10,265	Permittee	103
		\$33,666		\$472
<u>1983 Improvements</u>				
Cattle guards	4 each	\$10,400	BLM	
<u>Proposed Range Improvements^c</u>				
Jim Creek pipeline and trough	1 trough	2,805	Permittee	56
Upper Sheep pipeline and trough	5 troughs	22,400	Permittee	448
North Allaback pipeline and trough	2 troughs	9,760	Permittee	195
South Allaback pipeline and trough	1 trough	5,280	Permittee	106
Lower Mahala pipeline	1 mile	3,300	Permittee	66
		\$43,545		871 ^d
Increased herding necessary for the grazing system			Permittee	730
TOTAL		\$192,926		\$3,126

^a Estimated as a percentage of implementation cost as given by USDA-SCS (1981).

^b Excluding "control" pasture fences and Mahala Creek vegetation and wildlife exclosure fence which are a cost of research not the grazing system.

^c For a complete description of each improvement see the Saval Coordinated Management Plan (USDI-BLM 1981a). Improvements listed reflect improvements from the original list of proposed improvements that could still potentially be implemented in the future.

^d Estimated from labor data collected on the Saval Ranch during 1982 (Torell *et al.*, in press).

Benefit/Cost Analysis of Lower Sheep Creek Seeding (Option 4)

As outlined in Table 12, the cost of plowing and seeding the Lower Sheep Creek Pasture was estimated at \$32.18 per acre. The relevant question is whether this expenditure reflects a worthwhile expenditure of federal funds. In this section we compare the traditional grazing scheme with crested wheatgrass stands grazed early every spring (April through May) and again in the fall when forage availability permits.

To evaluate the benefits of the seeding to the Saval Ranch in terms of increased livestock production, the estimated 1,282 AUM's of forage available after seeding (Table 1) were included in the Saval LP model. All other resources were held constant at existing levels. Livestock parameters assumed under this option are the same as Option 3, which included improved livestock production. Wean crop is assumed to be 80 percent and selling weights have been increased to 715 pounds for steer yearlings, 355 pounds for heifer calves, and 395 pounds for steer calves.

With the additional forage, the optimal number of brood cows would be increased to 734 head (Table 14) as compared to 670 head before implementing the seeding. A cow-calf/yearling operation would continue to be optimal. With ample grazing forage, winter feed would become the most limiting factor to livestock production with all hayland harvested for hay and an additional 196 AUM's (78 tons) of hay purchased (Table 14).

Comparing the Ranch Income Statement presented as Table 9 (Optimal livestock production without the seeding) with Table 14 (Optimal livestock production with the seeding), one can see that

Table 14. Ranch Income Statement for Livestock Production with the Addition of the Lower Sheep Creek Seeding, Improved Calf Crop and Calf/Yearling Selling Weights, Optimal Herd Size (Option 4).

-----INCOME-----			
	\$/CWT	LBS.	TOTAL
285 STEER YEARLINGS	71.38	715	145348
147 HEIFER CALVES	68.27	355	35578
125 CULL COWS	44.01	950	52170
10 CULL BULLS	59.43	1400	8061
GROSS INCOME			241158
-----PRODUCTION COSTS-----			
I. FEED COSTS	\$/UNIT		TOTAL
6978 AUMS FED. FDRAGE	2.02		14095
1708 ACRES RAISED HAY			
LABOR	16.73		28579
FUEL	6.77		11565
REPAIRS	4.16		7106
SUPPLIES	2.40		4100
SUBTOTAL	30.06		51350
78 TON PURCHASED HAY	68.00		5277
D ACRES IRRIG. PASTURE			
LABOR	8.64		0
FUEL	0.68		0
FENCING	0.21		0
REPAIRS	0.49		0
SUBTOTAL	10.02		0
TOTAL FEED COSTS			70721
II. NON-FEED COSTS	\$/COW		TOTAL
734 HEAD OF COWS			
LABOR	50.10		36773
VEHICLE REPAIR	5.00		3670
GAS & OIL	12.67		9300
GENERAL SUPPLIES	3.93		2885
GENERAL MAINTENANCE	2.79		2048
OFFICE EXPENSES	0.18		132
ACCOUNTING	0.83		609
VETERINARY & MED.	5.28		3876
FREIGHT & HAULING	2.06		1512
BRAND INSPECTION	0.34		250
SALT & MINERALS	3.30		2422
MARKETING	1.33		976
SUBTOTAL	87.81		64453
285 HEAD OF YEARLINGS			
LABOR	35.79		10193
GRAIN PELLETS	12.10		3446
SUBTOTAL	47.89		13639
TOTAL NONFEED COSTS			78091
TOTAL VARIABLE COSTS			148813
III. FIXED COSTS			
TELEPHONE			1865
UTILITIES			13362
INSURANCE			8678
TAXES			6273
DEPRECIATION			37756
TOTAL FIXED COSTS			67934
IV. RETURNS			
RETURN OVER VARIABLE COSTS			92345
RETURN TO LAND & CAPITAL			24411

net ranch income would increase. Gross livestock sales would increase \$21,028 from \$220,130 to \$241,158, while variable production costs would increase by \$15,265. The net change in ranch income is then estimated to be \$5,763 per year. This would represent an average annual net return to the ranch of \$5.93 per AUM added by the seeding [$\$5,763 \div (\text{net forage added} = 1,282 \text{ AUM's} - 310 \text{ existing AUM's} = 972 \text{ AUM's})$]. This suggests that the Lower Sheep Creek Seeding is very beneficial to the ranch operation, but does not consider the costs to the BLM of implementing the seeding and the investment by the ranch in additional cows and bulls required to utilize the additional grazing resource. This investment must be considered as a side calculation to LP model results. Table 15 presents a summary of these calculations and a benefit/cost analysis of the seeding project. Present net worth of the seeding is estimated to be minus \$20,167 or an equivalent benefit/cost ratio of 0.93. Thus, under the traditional grazing pattern when all costs (federal and private) are considered, the Lower Sheep Creek Seeding is not estimated to be cost effective if only livestock benefits are considered.

There are at least three reasons why the Lower Sheep Creek Seeding would not have positive economic benefits under this option. First, the Saval Ranch already has a 4,200 acres of existing crested wheatgrass that are generally adequate for spring forage requirements. Second, winter feed is the most limiting forage resource on the ranch and developing additional grazing

Table 15. Benefit/Cost Analysis of the Lower Sheep Creek Seeding under Traditional Grazing Patterns.

<u>Annual Benefits</u>	
Increased livestock sales	\$21,028
Increased grazing fees (972 AUM's @ \$2.02) ^a	<u>1,963</u>
Total Annual Benefit	\$22,991
<u>Annual Costs</u>	
Increased production costs	15,265
Seeding maintenance cost (from Table 17)	<u>782</u>
Net Annual Benefit	\$ 6,944
Present value of \$6,944 (50 years @ 7-7/8%)	86,186
Present value of \$28,800 worth of breeding stock from year 50 ^b	651
Required range improvement investment (from Table 12)	-78,204
Purchase of 64 additional cows and 4 bulls	-28,800
Present Net Worth	\$-20,167
Internal Rate of Return (IRR)	6.26%
Benefit/Cost Ratio	.93

^aAlthough grazing fees reflect out-of-pocket costs for the Saval Ranch they are merely transfer payments from the point of view of society. Therefore, grazing fees should be excluded from the calculations of the change in net income when deriving the marginal value of forage to society (Brown 1982). To account for this, since the additional grazing fees are included in the \$15,265 increase in livestock production costs for the Saval Ranch, an equivalent amount, \$1,963 ($\$2.02 \times 972 \text{ AUM's} = \$1,963$) is added as a benefit. The \$2.02 fee used in the analysis reflects the 1979-81 average of Federal grazing fees.

^bIn order for the Saval to fully utilize the additional grazing resource, herd size must be expanded by 64 cows and 4 bulls. At the end of the 50 year planning horizon the investment in additional livestock is added back as a benefit. Mature cows were valued at \$400 per head, and additional purchased bulls were valued at \$800 per head and discounted to present value.

resources does not solve the more important need for winter feed. Without developing and/or improving existing hayland production on the ranch, additional grazing forage will only add to the existing forage imbalance. The third reason why the seeding was not estimated to yield positive economic returns was the diverse species planted for the new seeding. The policy of not planting a monoculture of crested wheatgrass increased seed cost by \$7.30 per acre or by \$17,738 for the total 2,430 acres seeded. Had this expense not been incurred, the present net worth of the seeding would be estimated at minus \$2,429 as compared to minus \$20,167 with the additional seed cost. The seeding would have been basically a break-even investment (considering only livestock benefits).

ECONOMICS OF HAY MEADOW IMPROVEMENT

Several improvement schemes for the Saval Ranch hay meadows have been proposed including land leveling, irrigation ditch, and water way improvement and fertilization. Leland Campsey, District Conservationist, Soil Conservation Service, estimates that more than \$200,000 would be required to totally improve the irrigation efficiency of the Saval Ranch.¹² The ranch owners realize the long-term benefits of meadow and irrigation improvements, but this initial cost coupled with the current relatively high interest rates has discouraged implementation of these improvements.

Irving Hackett, State Extension Range Specialist, has suggested that hayland acreages be fertilized as an alternative action to improving irrigation efficiency. This proposal is based upon an extensive number of fertilization trials on Elko County native hay meadows, including trails on the Saval Ranch. The specific recommendation is to apply 100 pounds of ammonium nitrate per acre on the most productive and best watered haylands.¹³ It is estimated that 1/3 of the hayland on the Saval would respond satisfactorily to meadow fertilization. With a total of 1,708 acres of hayland on the Saval, Tremewan and Haystack Units, a total of 564 acres would be satisfactory sites for fertilization. Meadow fertilization would increase hay yields by an estimated 1.25 tons per acre for a total yield of 2.10 tons per acre.¹³

The estimated cost of the fertilizer, fertilizer application and a slight increase in haying expenses due to heavier hay production is estimated to be \$40 per acre. This would amount to a

total annual cost of approximately \$22,560 if 1/3 of the hay meadows (564 acres) were fertilized each year.

The above meadow fertilization scheme was examined using the Saval LP model. Two options relating the Lower Sheep Creek Seeding and meadow fertilization are presented. Option 5 considers meadow fertilization without additional spring/fall forage available from the new seeding. Option 6 considers the economics of meadow fertilization when additional forage from the seeding is considered to be available for grazing.

Lower Sheep Creek Seeding not Available (Option 5)

When suitable hay meadows are fertilized and when additional forage from the Lower Sheep Creek Seeding is assumed not to be available, spring, summer, and fall forage becomes the factor limiting livestock production. Only 1,039 acres of hayland would optimally be harvested for winter feed with 669 acres grazed as irrigated pasture (Table 16). Optimal herd size would be 762 brood cows operated as a cow-calf/yearling operation.

Compared to optimal production without meadow fertilization (Table 9), net ranch income is estimated to increase by \$9,963 to \$28,631 (Table 16). This would reflect a \$17.66 net return per acre fertilized, and would represent a 44 percent return on the assumed \$40 annual fertilizer investment.

Table 16. Ranch Income Statement for Livestock Production with Meadow Fertilization, Improved Calf Crop and Calf/Yearling Selling Weights, Optimal Herd Size (Option 5).

-----INCOME-----			
	\$/CWT	LBS.	TOTAL
296 STEER YEARLINGS	71.38	715	150893
152 HEIFER CALVES	68.27	355	36936
130 CULL COWS	44.01	950	54160
10 CULL BULLS	59.43	1400	8369
GROSS INCOME			250357
----- PRODUCTION COSTS -----			
I. FEED COSTS	\$/UNIT		TOTAL
6054 AUMS FED. FORAGE	2.02		12230
1039 ACRES RAISED HAY			
LABOR	16.73		17380
FUEL	6.77		7033
REPAIRS	4.16		4322
SUPPLIES	2.40		2493
564 ACRES FERTILIZED	40.00		22560
SUBTOTAL	30.06		53787
0 TON PURCHASED HAY	68.00		0
669 ACRES IRRIG. PASTURE			
LABOR	8.64		5782
FUEL	0.68		455
FENCING	0.21		141
REPAIRS	0.49		328
SUBTOTAL	10.02		6705
TOTAL FEED COSTS			72722
II. NON-FEED COSTS	\$/COW		TOTAL
762 HEAD OF COWS			
LABOR	50.10		38176
VEHICLE REPAIR	5.00		3810
GAS & OIL	12.67		9655
GENERAL SUPPLIES	3.93		2995
GENERAL MAINTENANCE	2.79		2126
OFFICE EXPENSES	0.18		137
ACCOUNTING	0.83		632
VETERINARY & MED.	5.28		4023
FREIGHT & HAULING	2.06		1570
BRAND INSPECTION	0.34		259
SALT & MINERALS	3.30		2515
MARKETING	1.33		1013
SUBTOTAL	87.81		66911
296 HEAD OF YEARLINGS			
LABOR	35.79		10582
GRAIN PELLETS	12.10		3577
SUBTOTAL	47.89		14159
TOTAL NONFEED COSTS			81070
TOTAL VARIABLE COSTS			153792
III. FIXED COSTS			
TELEPHONE			1865
UTILITIES			13362
INSURANCE			8678
TAXES			6273
DEPRECIATION			37756
TOTAL FIXED COSTS			67934
IV. RETURNS			
RETURN OVER VARIABLE COSTS			96565
RETURN TO LAND & CAPITAL			28631

Lower Sheep Creek Seeding Available (Option 6)

With the addition of the Lower Sheep Creek Seeding and with meadow fertilization, ranch income would increase much more than when either improvement option is considered independently. This is true because additional grazing resources and winter feed would allow the ranch to maintain forage balance. When only additional hay is added, spring, summer, and fall forage becomes limiting while winter feed is limiting if only the seeding is implemented.

When both improvements are considered simultaneously, the optimal cow herd size would be 816 head with the ranch operation operated as a cow-calf/yearling unit (Table 17). Summer and fall forage availability would be the factor limiting the size of the herd. The ranch would have year-long forage balance with a total annual forage requirement of 14,991 AUM's.

Comparison of the ranch income statement for this option with the current resources ranch income statement (Table 9) shows that the additional grazing and hay resources would add significantly to ranch income. Gross livestock sales would increase by \$47,969 to \$268,099. Variable costs would increase by \$30,495, but this is less than the increase in livestock sales. Return to land and capital was estimated to increase by \$17,474. This increase in ranch income is \$1,728 higher than when the two improvements, meadow fertilization and the addition of the Lower Sheep Creek Seeding, are considered independently and the resulting increase in ranch incomes added together.¹⁴ This result is obtained because of better forage balance with the addition of both grazing and hay resources.

Table 17. Ranch Income Statement for Livestock Production with Meadow Fertilization, Addition of the Lower Sheep Creek Seeding, Improved Calf Crop and Calf/Yearling Selling Weights, Optimal Herd Size (Option 6).

-----INCOME-----			
	\$/CWT	LBS.	TOTAL
317 STEER YEARLINGS	71.38	715	161586
163 HEIFER CALVES	68.27	355	39553
139 CULL COWS	44.01	950	57998
11 CULL BULLS	59.43	1400	8952
GROSS INCOME			268099
----- PRODUCTION COSTS -----			
I. FEED COSTS	\$/UNIT		TOTAL
6978 AUMS FED. FORAGE	2.02		14095
1171 ACRES RAISED HAY			
LABOR	16.73		19584
FUEL	6.77		7925
REPAIRS	4.16		4870
SUPPLIES	2.40		2809
564 ACRES FERTILIZED	40.00		22560
SUBTOTAL	30.06		57748
0 TON PURCHASED HAY	68.00		0
537 ACRES IRRIG. PASTURE			
LABOR	8.64		4643
FUEL	0.68		365
FENCING	0.21		113
REPAIRS	0.49		263
SUBTOTAL	10.02		5385
TOTAL FEED COSTS			77228
II. NON-FEED COSTS	\$/COW		TOTAL
816 HEAD OF COWS			
LABOR	50.10		40882
VEHICLE REPAIR	5.00		4080
GAS & OIL	12.67		10339
GENERAL SUPPLIES	3.93		3207
GENERAL MAINTENANCE	2.79		2277
OFFICE EXPENSES	0.18		147
ACCOUNTING	0.83		677
VETERINARY & MED.	5.28		4308
FREIGHT & HAULING	2.06		1681
BRAND INSPECTION	0.34		277
SALT & MINERALS	3.30		2693
MARKETING	1.33		1085
SUBTOTAL	87.81		71653
317 HEAD OF YEARLINGS	\$/HEAD		
LABOR	35.79		11331
GRAIN PELLETS	12.10		3831
SUBTOTAL	47.89		15162
TOTAL NONFEED COSTS			86815
TOTAL VARIABLE COSTS			164043
III. FIXED COSTS			
TELEPHONE			1865
UTILITIES			13362
INSURANCE			8678
TAXES			6273
DEPRECIATION			37756
TOTAL FIXED COSTS			67934
IV. RETURNS			
RETURN OVER VARIABLE COSTS			104056
RETURN TO LAND & CAPITAL			36122

The effect of meadow fertilization would vary from year to year as influenced by water availability. This variability would have to be weighted heavily in any decision to fertilize hay meadows. However, the economic results outlined above suggest that the result of fertilization could be considerably less than the estimated 1.25 tons per acre and still result in a profitable practice.

One major problem with the meadow fertilization scheme as outlined is that it does not address or solve the more long-term problem of poor water distribution on hay meadows. However, even though the meadow fertilization scheme has been outlined and referred to as "fertilization", the results can be interpreted differently. The analysis assumes that \$22,560 would be spent on meadow improvement per year. It makes no difference whether this expenditure is on fertilizer as assumed or loan payments for piping, grading, reservoir development, ditching, etc., if a 1.25 ton per acre hay yield increase is obtained.

The option considered here, improved livestock production, implementation of the Lower Sheep Creek Seeding, and meadow improvement reflects the estimated "best" production with the baseline resources available on the Saval Ranch when traditional grazing patterns are followed. It results in considerable improvement over existing management as a cow-calf operation without range and hayland improvement. Return to land and capital is estimated to increase from minus \$25,979 for Option 1

(traditional cow-calf operation) to a positive \$36,122 for this option--a \$62,101 increase in ranch returns (Table 20).

To further highlight the importance of maintaining seasonal forage balance, using information developed under Options 5 and 6, and similar to Table 15, Table 18 once again outlines the economics of the Lower Sheep Creek Seeding. However, in this case it is assumed that the Saval Ranch is already fertilizing 1/3 of available hayland (increasing hay production by an estimated 705 tons) such that spring, summer, and fall forage represents the constraint on livestock production. With the addition of the Lower Sheep Creek Seeding and given adequate hay resources, optimal herd size would be 816 head (Option 6). Livestock sales would increase by \$17,142.

Under the condition of adequate winter feed, the economics of the seeding is positive. Present net worth is positive \$5,971 and the B/C ratio is 1.03. One could conclude, then, that the Lower Sheep Creek seeding will be profitable only if the existing hay shortage on the Saval Ranch is eliminated or equivalent steps are taken to provide relatively inexpensive winter feed. The seeding does little to alleviate the shortage of winter feed on the ranch. Saval Ranch planners must consider alternative ways of providing additional winter feed: perhaps meadow fertilization as outlined above, meadow improvement, shipping the cows to a warmer climate for winter grazing, and/or alternative schemes. Without additional relatively cheap winter feed sources, additional spring, summer and fall forage resources from seedings and/or the grazing system cannot be economically harvested.

Table 18. Benefit/Cost Analysis of the Lower Sheep Creek Seeding under Traditional Grazing Patterns when Range Forage is the Limiting Resource.

<u>Annual Benefits</u>		
Increased livestock sales	\$	17,742
Increased grazing fees (972 AUM's @ \$2.02)		<u>1,963</u>
Total Annual Benefit	\$	19,705
<u>Annual Costs</u>		
Increased production costs	\$	10,251
Seeding maintenance cost		<u>782</u>
Net Annual Benefit	\$	8,672
Present value of \$8,672 (50 years @ 7-1/8%)		107,633
Present value of \$24,000 worth of breeding stock from Year 50		542
Required range improvement investment		-78,204
Purchase of 54 additional cows and 3 bulls		-24,000
Present Net Worth	\$	5,971
Internal Rate of Return (IRR)		8.36%
Benefit/Cost Ratio		1.03

Effect of Meadow Improvement on Resource Values

Much insight into the interrelationship of seasonal forage resources and corresponding forage values can be gained by comparing what is called an LP shadow price. A shadow price reflects what one could afford to pay for another unit of the resource. It reflects the amount by which the value of the LP objective function (returns over variable costs in this case) would increase from a one-unit increase in the resource in question, when all remaining resources are fixed at their original levels (for further information on LP shadow prices see Pfaffenberger and Walker (1976) or any other operations research text which covers linear programming).

Table 19 presents shadow prices for fertilized meadowland and BLM and USFS range under alternative assumptions about the level of meadow fertilization. The first option considers moving from existing hay production practices, whereby no acreages are fertilized or improved, to improvement of one acre. Thus, it considers the value at the margin of meadow fertilization, given a level of grazing resource availability that includes the Lower Sheep Creek Seeding, and improved livestock production. The second alternative considers the marginal value of the various resource classes when 1/3 of the available hayland is already being fertilized.

With no meadow fertilization or meadow improvements, the marginal value of switching to this practice is estimated to be \$45.06 per acre. This means that the first acre fertilized would increase net ranch returns by about \$45. This high return for

Table 19. The Effect of Meadow Improvement on Marginal Resource Values.

Alternative Description	LP Shadow Price		Most Limiting Season Forage
	Fertilized Hayland	BLM and USFS Range	
No meadow fertilization, Sheep Creek Seeding in place	\$45.06/Acre	\$4.20/AUM	Winter Feed
Currently fertilizing 1/3 of available hayland, Sheep Creek Seeding in place	\$17.72	\$7.70	Spring, Summer and Fall Grazing

development of additional hay resource is to be expected when winter feed is the most limiting resource.

If the assumed cost of meadow improvement of \$40 per acre is added to the per acre shadow price, it can be seen that the gross value of fertilizing the first acre of hayland is \$85. Dividing this value by the 1.25 ton yield increase from fertilizing results in a value per ton of additional hay produced of \$68. This is the expected model result because the value to the ranch of an additional homegrown ton of hay can be no more than the cost of purchasing hay from off the ranch which was estimated to be \$68 per ton.

The model results exhibit the expected declining marginal value from meadow improvement. When 1/3 of available hayland (564 acres) is already being fertilized, the net return from fertilizing one additional acre is estimated to be \$17.72 per acre. In this case, spring, summer, and fall grazing represents the most limiting seasonal resource. Following a procedure similar to the one outlined above, it can be seen that when spring/summer/fall grazing rather than winter feed is most limiting, the ranch cannot afford to pay more than about \$46 per ton of hay.

Federal forage resource values are also significantly affected by the level of meadow improvement. When winter feed (hay) is the most limiting seasonal resource, the marginal value of an additional AUM from federally administered lands (BLM or USFS) is estimated to be \$4.20. If, however, spring/summer or fall grazing is most limiting, the marginal value of an additional AUM of federal grazing is estimated to be \$7.70. This represents an 83 percent difference in value based totally on the seemingly

unrelated level of assumed hay production. This points out the strong correlation and importance of various seasonal forage resources in maintaining year-round forage balance and ranch profitability.

SUMMARY OF ALTERNATIVE SEASON-LONG MANAGEMENT ALTERNATIVES

Alternative livestock management options and range and meadow improvements for the Saval Ranch were analyzed using linear programming and discounting. The analysis considered the optimal level of production (number of cows), improved calf crop and calf/yearling selling weights, the economics of meadow fertilization, and the economics of the new Lower Sheep Creek Seeding. All of these options were considered under a season-long grazing pattern. Table 20 summarizes the results.

When only existing forage resources are considered to be available and with management as a cow/calf operation, the optimal cow herd size is estimated to be 821 head. Return to land and capital was estimated to be minus \$25,979. With cow herd size at the optimal number of 689 head and with management as a cow-calf/-yearling operation, net returns were estimated to increase by \$16,757 from Option 1.

A 10 percent increase in weaning percentage coupled with heavier weaning weights was estimated to result in a \$27,870 increase in net annual returns. The new Lower Sheep Creek Seeding is estimated to add \$5,763 annually to ranch returns. However, when federal costs of implementing the seeding are also considered, the seeding is not estimated to be cost effective (result in

Table 20. A summary of the economics of alternative season-long grazing management options.

Option Number	Management Alternative Description	Ranch Income Statement	Optimal Number of Cows	Return to Land and Capital	Change From Option One
			(Head)	-----dollars-----	
1	Optimal Herd Size Cow/calf operation	Table 6	821	-25,979	---
2	Cow/calf/yearling operation	Table 7	689	- 9,222	16,757
3	Optimal Herd Size, Increased Calf crop and selling weights Cow/calf/yearling operation	Table 9	670	18,648	44,627
4	Optimal Herd Size, Increased Calf crop and selling weights Add the Lower Sheep Creek Seeding Cow/calf/yearling operation	Table 14	734	24,411	50,390
5	Optimal Herd Size, Increased Calf crop and selling weights Fertilize 1/3 of hayland Cow/calf/yearling operation	Table 16	762	28,631	54,610
6	Optimal Herd Size, Increased Calf Crop and selling weights, add the Lower Sheep Creek Seeding, Fertilize 1/3 of hayland Cow/calf/yearling operation	Table 17	816	36,122	62,101

benefits greater than costs) if the current shortage of winter feed on the ranch persists.

The most limiting and most variable resource on the Saval is winter feed (hay), therefore, development of additional winter feed sources is of primary importance if additional spring, summer and fall grazing is to be used beneficially. Undertaking a meadow fertilization program, given an optimal herd size and increased levels of livestock production, would increase net returns by an estimated \$9,983 per year, a \$17.70 per acre annual net return (comparing Option 3 with Option 5).

Compared to the current production strategy on the Saval (Option 1), adding all of the outlined management adjustments, the Lower Sheep Creek Seeding with season-long grazing, and fertilizing suitable hayland acreages results in a \$62,101 estimated increase in net ranch returns.

SECTION III
OPTIMAL LIVESTOCK PRODUCTION
UNDER THE SAVAL RANCH GRAZING SYSTEM

GRAZING SYSTEM DESCRIPTION

A different grazing management system was developed for each non-irrigated forage source available on the Saval Ranch (Table 21). These management systems are designed to provide deferment or rest of range forage from grazing during a portion of, or over the entire grazing season. Deferment or rest will permit desirable plants to periodically complete their life cycle. This will in turn increase vigor, productivity, seed production, and density of desirable plant species.

Under the Saval Ranch management plan, grass hay is harvested from meadows in July and August and fed to cattle from December until the middle of April. Regrowth following haying is grazed by cattle during October and November as animals return from summer rangelands. Crested wheatgrass seedings are grazed under a three-pasture deferred-rotation system. In each year one pasture is grazed from April 15 to May 8, one pasture from May 9 to May 30, and one pasture from November 1 to November 30. Low-elevation BLM native range is grazed under a three-pasture rest-rotation system. In each year one pasture is grazed from June 1 to June 15, one pasture is grazed from June 16 to June 30, and one pasture is rested the entire grazing season. High-elevation USFS native range is grazed under a two-pasture deferred rotation system. In each year, one pasture is grazed from July 1 to August 15, and one pasture is grazed from August 16 to September 30. The use of each pasture in all three grazing systems is rotated yearly as shown in Table 21.

Table 21. Grazing Schedule for each Forage Type by Ownership.

1. BLM seeded range - Three-Pasture, Deferred-Rotation System

Pasture	Year		
	1	2	3
	Treatment		
1. East Darling Seeding	A	B	C
2. Lower Sheep Creek Seeding	B	C	A
3. West Darling Seeding	C	A	B

2. BLM Native Range - Three-Pasture, Rest Rotation System

Pasture	Year		
	1	2	3
	Treatment		
1. Upper Sheep Creek	D	E	F
2. Upper Mahala Creek	E	F	D
3. Middle Mahala Creek	F	D	E

3. USFS Native Range - Two-Pasture, Deferred-Rotation System

Pasture	Year			
	1	2	3	4
	Treatment			
1. South Independence	G	H	G	H
2. North Independence	H	G	H	G

Treatment	A	---	graze	4/15	---	5/8
	B	---	graze	11/1	---	11/30
	C	---	graze	5/9	---	5/30
	D	---	graze	6/1	---	6/15
	E	---	graze	6/16	---	6/30
	F	---	REST			
	G	---	graze	7/1	---	8/15
	H	---	graze	8/16	---	9/30

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